IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

VOCALIFE LLC, *Plaintiff,* v. AMAZON.COM, INC., AMAZON.COM LLC, *Defendants.*	§ § § § § § § § § §	CIVIL ACTION NO. 2:19-CV-00123-JRG

CLAIM CONSTRUCTION MEMORANDUM OPINION AND ORDER

Before the Court is the opening claim construction brief of Vocalife LLC ("Plaintiff") (Dkt. No. 68),[1] the response of Amazon.com, Inc. and Amazon.com LLC (collectively "Defendants") (Dkt. No. 69), and Plaintiff's reply (Dkt. No. 75). The Court held a hearing on the issues of claim construction and claim definiteness on March 24, 2020. Having considered the arguments and evidence presented by the parties at the hearing and in their briefing, the Court issues this Order.

[1] Citations to the parties' filings are to the filing's number in the docket (Dkt. No.) and pin cites are to the page numbers assigned through ECF.

Table of Contents

I. BACKGROUND

Plaintiff alleges infringement of U.S. Patent No. RE47,049 (the "'049 Patent"). The '049 Patent is entitled Microphone Array System. The '049 Patent is a reissue of U.S. Patent No. 8,861,756 and lists an earliest priority claim to U.S. Patent Application No. 61/403,952, filed on September 24, 2010.

In general, the '049 Patent is directed to technology for "enhancing acoustics of a target sound signal received from a target sound source, while suppressing ambient noise signals." '049 Patent col.2 ll.6–8. The general approach utilizes an array of sound sensors such as microphones. The array does not require a specific geometric configuration. *Id*. at col.2 ll.23–26, col.3 ll.45–53. The array has a directivity pattern, which denotes the array's response as a function of frequency and direction of the sound signal. *Id*. at col.5 l.51 – col.6 l.5. Figures 16D and 16E, reproduced and annotated below, depict an exemplary directivity pattern for an eight-sensor array steered to 15°. *Id*. at col.16 l.55 – col.18 l.43.[2] The patent describes forming and steering the directivity pattern

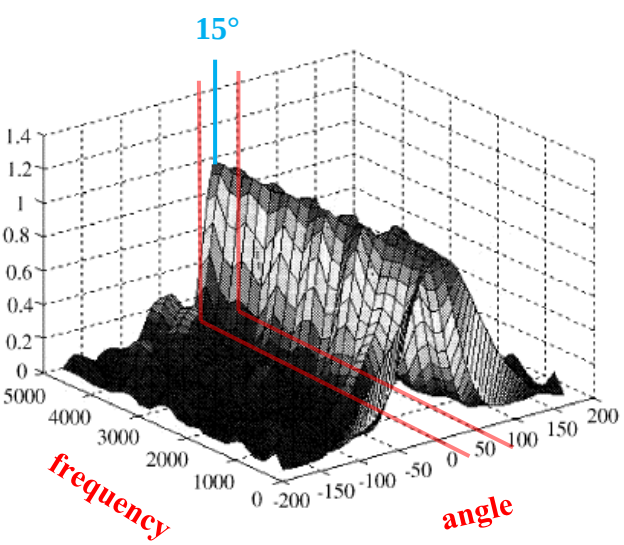

FIG. 16D

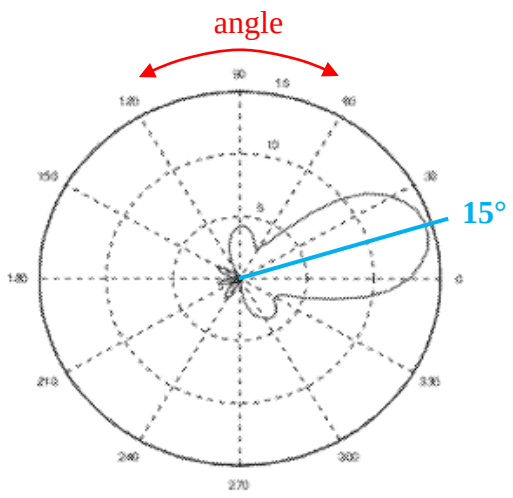

FIG. 16E

[2] The '049 Patent describes Figure 16D as depicting a directivity pattern steered to 60° but the peak of the pattern is at 15° in the figure. The pattern depicted in Figure 16C is described as steered to 15° but is depicted as peaked at 60°.

by determining the relative timing of receipt of the target signal at each sensor in the array and applying filter-weights to each sensor that are based on this relative timing. *Id*. at col.7 l.33 – col.11 l.21. Different filter-weights yield different directivity patterns. *Id*. For example, Figures 16E through 16L depict different directivity patterns for the microphone array depicted in Figures 16A and 16B. The patterns are steered toward different angular positions by applying different filter-weights to the microphones of the array. *Id*. at col.16 l.55 – col.18 l.43.

The abstract of the ’049 Patent provides:

> A method and system for enhancing a target sound signal from multiple sound signals is provided. An array of an arbitrary number of sound sensors positioned in an arbitrary configuration receives the sound signals from multiple disparate sources. The sound signals comprise the target sound signal from a target sound source, and ambient noise signals. A sound source localization unit, an adaptive beamforming unit, and a noise reduction unit are in operative communication with the array of sound sensors. The sound source localization unit estimates a spatial location of the target sound signal from the received sound signals. The adaptive beamforming unit performs adaptive beamforming by steering a directivity pattern of the array of sound sensors in a direction of the spatial location of the target sound signal, thereby enhancing the target sound signal and partially suppressing the ambient noise signals, which are further suppressed by the noise reduction unit.

Claim 1 of the ’049 Patent, an exemplary method claim, recites as follows (with deletions from U.S. Patent No. 8,861,756 denoted with strikethrough and additions denoted with underline):

> **1.** A method for enhancing a target sound signal from a plurality of sound signals, comprising:
>
> providing a microphone array system comprising an array of sound sensors positioned in ~~an arbitrary~~ a linear, circular, or other configuration, a sound source localization unit, an adaptive beamforming unit, and a noise reduction unit, wherein said sound source localization unit, said adaptive beamforming unit, and said noise reduction unit are integrated in a digital signal processor, and wherein said sound source localization unit, said adaptive beamforming unit, and said noise reduction unit are in operative communication with said array of said sound sensors;
>
> receiving said sound signals from a plurality of disparate sound sources by said sound sensors, wherein said received sound signals comprise said target sound signal from a target sound source among said disparate sound sources, and ambient noise signals;
>
> determining a delay between each of said sound sensors and an origin of said array of said sound sensors as a function of distance between each of said

sound sensors and said origin, a predefined angle between each of said sound sensors and a reference axis, and an azimuth angle between said reference axis and said target sound signal, when said target sound source that emits said target sound signal is in a two dimensional plane, wherein said delay is represented in terms of number of samples, and wherein said determination of said delay enables beamforming for ~~arbitrary numbers of~~ said array of sound sensors ~~and~~ in a plurality of ~~arbitrary~~ configurations ~~of said array of said sound sensors~~;

estimating a spatial location of said target sound signal from said received sound signals by said sound source localization unit;

performing adaptive beamforming for steering a directivity pattern of said array of said sound sensors in a direction of said spatial location of said target sound signal by said adaptive beamforming unit, wherein said adaptive beamforming unit enhances said target sound signal and partially suppresses said ambient noise signals; and suppressing said ambient noise signals by said noise reduction unit for further enhancing said target sound signal.

II. LEGAL PRINCIPLES

A. Claim Construction

"It is a 'bedrock principle' of patent law that 'the claims of a patent define the invention to which the patentee is entitled the right to exclude.'" *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc) (quoting *Innova/Pure Water Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1115 (Fed. Cir. 2004)). To determine the meaning of the claims, courts start by considering the intrinsic evidence. *Id.* at 1313; *C.R. Bard, Inc. v. U.S. Surgical Corp.*, 388 F.3d 858, 861 (Fed. Cir. 2004); *Bell Atl. Network Servs., Inc. v. Covad Commc'ns Group, Inc.*, 262 F.3d 1258, 1267 (Fed. Cir. 2001). The intrinsic evidence includes the claims themselves, the specification, and the prosecution history. *Phillips*, 415 F.3d at 1314; *C.R. Bard, Inc.*, 388 F.3d at 861. The general rule—subject to certain specific exceptions discussed *infra*—is that each claim term is construed according to its ordinary and accustomed meaning as understood by one of ordinary skill in the art at the time of the invention in the context of the patent. *Phillips*, 415 F.3d at 1312–13; *Alloc, Inc. v. Int'l Trade Comm'n*, 342 F.3d 1361, 1368 (Fed. Cir. 2003); *Azure Networks, LLC v. CSR PLC*, 771 F.3d 1336, 1347 (Fed. Cir. 2014) ("There is a heavy presumption

that claim terms carry their accustomed meaning in the relevant community at the relevant time.") (vacated on other grounds).

"The claim construction inquiry … begins and ends in all cases with the actual words of the claim." *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1248 (Fed. Cir. 1998). "[I]n all aspects of claim construction, 'the name of the game is the claim.'" *Apple Inc. v. Motorola, Inc.*, 757 F.3d 1286, 1298 (Fed. Cir. 2014) (quoting *In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998)). First, a term's context in the asserted claim can be instructive. *Phillips*, 415 F.3d at 1314. Other asserted or unasserted claims can also aid in determining the claim's meaning, because claim terms are typically used consistently throughout the patent. *Id.* Differences among the claim terms can also assist in understanding a term's meaning. *Id*. For example, when a dependent claim adds a limitation to an independent claim, it is presumed that the independent claim does not include the limitation. *Id*. at 1314–15.

"[C]laims 'must be read in view of the specification, of which they are a part.'" *Id*. (quoting *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 979 (Fed. Cir. 1995) (en banc)). "[T]he specification 'is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.'" *Id*. (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)); *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002). But, "'[a]lthough the specification may aid the court in interpreting the meaning of disputed claim language, particular embodiments and examples appearing in the specification will not generally be read into the claims.'" *Comark Commc'ns, Inc. v. Harris Corp.*, 156 F.3d 1182, 1187 (Fed. Cir. 1998) (quoting *Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 1571 (Fed. Cir. 1988)); *see also Phillips*, 415 F.3d at 1323. "[I]t is improper to read limitations from a preferred embodiment described in the specification—even if

it is the only embodiment—into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited." *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 913 (Fed. Cir. 2004).

The prosecution history is another tool to supply the proper context for claim construction because, like the specification, the prosecution history provides evidence of how the U.S. Patent and Trademark Office ("PTO") and the inventor understood the patent. *Phillips*, 415 F.3d at 1317. However, "because the prosecution history represents an ongoing negotiation between the PTO and the applicant, rather than the final product of that negotiation, it often lacks the clarity of the specification and thus is less useful for claim construction purposes." *Id.* at 1318; *see also Athletic Alternatives, Inc. v. Prince Mfg.*, 73 F.3d 1573, 1580 (Fed. Cir. 1996) (ambiguous prosecution history may be "unhelpful as an interpretive resource").

Although extrinsic evidence can also be useful, it is "'less significant than the intrinsic record in determining the legally operative meaning of claim language.'" *Phillips*, 415 F.3d at 1317 (quoting *C.R. Bard, Inc.*, 388 F.3d at 862). Technical dictionaries and treatises may help a court understand the underlying technology and the manner in which one skilled in the art might use claim terms, but technical dictionaries and treatises may provide definitions that are too broad or may not be indicative of how the term is used in the patent. *Id*. at 1318. Similarly, expert testimony may aid a court in understanding the underlying technology and determining the particular meaning of a term in the pertinent field, but an expert's conclusory, unsupported assertions as to a term's definition are not helpful to a court. *Id*. Extrinsic evidence is "less reliable than the patent and its prosecution history in determining how to read claim terms." *Id*. The Supreme Court has explained the role of extrinsic evidence in claim construction:

> In some cases, however, the district court will need to look beyond the patent's intrinsic evidence and to consult extrinsic evidence in order to understand, for

> example, the background science or the meaning of a term in the relevant art during the relevant time period. *See, e.g.*, *Seymour v. Osborne*, 11 Wall. 516, 546 (1871) (a patent may be "so interspersed with technical terms and terms of art that the testimony of scientific witnesses is indispensable to a correct understanding of its meaning"). In cases where those subsidiary facts are in dispute, courts will need to make subsidiary factual findings about that extrinsic evidence. These are the "evidentiary underpinnings" of claim construction that we discussed in *Markman*, and this subsidiary factfinding must be reviewed for clear error on appeal.

Teva Pharm. USA, Inc. v. Sandoz, Inc., 574 U.S. 318, 331–32 (2015).

B. Departing from the Ordinary Meaning of a Claim Term

There are "only two exceptions to [the] general rule" that claim terms are construed according to their plain and ordinary meaning: "1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of the claim term either in the specification or during prosecution."[3] *Golden Bridge Tech., Inc. v. Apple Inc.*, 758 F.3d 1362, 1365 (Fed. Cir. 2014) (quoting *Thorner v. Sony Computer Entm't Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012)); *see also GE Lighting Solutions, LLC v. AgiLight, Inc.*, 750 F.3d 1304, 1309 (Fed. Cir. 2014) ("[T]he specification and prosecution history only compel departure from the plain meaning in two instances: lexicography and disavowal."). The standards for finding lexicography or disavowal are "exacting." *GE Lighting Solutions*, 750 F.3d at 1309.

To act as his own lexicographer, the patentee must "clearly set forth a definition of the disputed claim term," and "clearly express an intent to define the term." *Id.* (quoting *Thorner*, 669 F.3d at 1365); *see also Renishaw*, 158 F.3d at 1249. The patentee's lexicography must appear "with reasonable clarity, deliberateness, and precision." *Renishaw*, 158 F.3d at 1249.

[3] Some cases have characterized other principles of claim construction as "exceptions" to the general rule, such as the statutory requirement that a means-plus-function term is construed to cover the corresponding structure disclosed in the specification. *See, e.g.*, *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1367 (Fed. Cir. 2002).

To disavow or disclaim the full scope of a claim term, the patentee's statements in the specification or prosecution history must amount to a "clear and unmistakable" surrender. *Cordis Corp. v. Boston Sci. Corp.*, 561 F.3d 1319, 1329 (Fed. Cir. 2009); *see also Thorner*, 669 F.3d at 1366 ("The patentee may demonstrate intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope."). "Where an applicant's statements are amenable to multiple reasonable interpretations, they cannot be deemed clear and unmistakable." *3M Innovative Props. Co. v. Tredegar Corp.*, 725 F.3d 1315, 1326 (Fed. Cir. 2013).

C. Functional Claiming and 35 U.S.C. § 112, ¶ 6 (pre-AIA) / § 112(f) (AIA)

A patent claim may be expressed using functional language. *See* 35 U.S.C. § 112, ¶ 6; *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1347–49 & n.3 (Fed. Cir. 2015) (en banc in relevant portion). Section 112, Paragraph 6, provides that a structure may be claimed as a "means … for performing a specified function" and that an act may be claimed as a "step for performing a specified function." *Masco Corp. v. United States*, 303 F.3d 1316, 1326 (Fed. Cir. 2002).

But § 112, ¶ 6 does not apply to all functional claim language. There is a rebuttable presumption that § 112, ¶ 6 applies when the claim language includes "means" or "step for" terms, and that it does not apply in the absence of those terms. *Masco Corp.*, 303 F.3d at 1326; *Williamson*, 792 F.3d at 1348. The presumption stands or falls according to whether one of ordinary skill in the art would understand the claim with the functional language, in the context of the entire specification, to denote sufficiently definite structure or acts for performing the function. *See Media Rights Techs., Inc. v. Capital One Fin. Corp.*, 800 F.3d 1366, 1372 (Fed. Cir. 2015) (§ 112, ¶ 6 does not apply when "the claim language, read in light of the specification, recites sufficiently definite structure" (quotation marks omitted) (citing *Williamson*, 792 F.3d at 1349; *Robert Bosch, LLC v. Snap-On Inc.*, 769 F.3d 1094, 1099 (Fed. Cir. 2014))); *Williamson*, 792 F.3d

at 1349 (§ 112, ¶ 6 does not apply when "the words of the claim are understood by persons of ordinary skill in the art to have sufficiently definite meaning as the name for structure"); *Masco Corp.*, 303 F.3d at 1326 (§ 112, ¶ 6 does not apply when the claim includes an "act" corresponding to "how the function is performed"); *Personalized Media Communications, L.L.C. v. International Trade Commission*, 161 F.3d 696, 704 (Fed. Cir. 1998) (§ 112, ¶ 6 does not apply when the claim includes "sufficient structure, material, or acts within the claim itself to perform entirely the recited function … even if the claim uses the term 'means.'" (quotation marks and citation omitted)).

When it applies, § 112, ¶ 6 limits the scope of the functional term "to only the structure, materials, or acts described in the specification as corresponding to the claimed function and equivalents thereof." *Williamson*, 792 F.3d at 1347. Construing a means-plus-function limitation involves multiple steps. "The first step … is a determination of the function of the means-plus-function limitation." *Medtronic, Inc. v. Advanced Cardiovascular Sys., Inc.*, 248 F.3d 1303, 1311 (Fed. Cir. 2001). "[T]he next step is to determine the corresponding structure disclosed in the specification and equivalents thereof." *Id.* A "structure disclosed in the specification is 'corresponding' structure only if the specification or prosecution history clearly links or associates that structure to the function recited in the claim." *Id.* The focus of the "corresponding structure" inquiry is not merely whether a structure is capable of performing the recited function, but rather whether the corresponding structure is "clearly linked or associated with the [recited] function." *Id.* The corresponding structure "must include all structure that actually performs the recited function." *Default Proof Credit Card Sys. v. Home Depot U.S.A., Inc.*, 412 F.3d 1291, 1298 (Fed. Cir. 2005). However, § 112 does not permit "incorporation of structure from the written description beyond that necessary to perform the claimed function." *Micro Chem., Inc. v. Great Plains Chem. Co.*, 194 F.3d 1250, 1258 (Fed. Cir. 1999).

For § 112, ¶ 6 limitations implemented by a programmed general purpose computer or microprocessor, the corresponding structure described in the patent specification must include an algorithm for performing the function. *WMS Gaming Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1349 (Fed. Cir. 1999). The corresponding structure is not a general purpose computer but rather the special purpose computer programmed to perform the disclosed algorithm. *Aristocrat Techs. Austl. Pty Ltd. v. Int'l Game Tech.*, 521 F.3d 1328, 1333 (Fed. Cir. 2008).

D. Definiteness Under 35 U.S.C. § 112, ¶ 2 (pre-AIA) / § 112(b) (AIA)

Patent claims must particularly point out and distinctly claim the subject matter regarded as the invention. 35 U.S.C. § 112, ¶ 2. A claim, when viewed in light of the intrinsic evidence, must "inform those skilled in the art about the scope of the invention with reasonable certainty." *Nautilus Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 910 (2014). If it does not, the claim fails § 112, ¶ 2 and is therefore invalid as indefinite. *Id.* at 901. Whether a claim is indefinite is determined from the perspective of one of ordinary skill in the art as of the time the application for the patent was filed. *Id.* at 911. As it is a challenge to the validity of a patent, the failure of any claim in suit to comply with § 112 must be shown by clear and convincing evidence. *BASF Corp. v. Johnson Matthey Inc.*, 875 F.3d 1360, 1365 (Fed. Cir. 2017). "[I]ndefiniteness is a question of law and in effect part of claim construction." *ePlus, Inc. v. Lawson Software, Inc.*, 700 F.3d 509, 517 (Fed. Cir. 2012).

When a term of degree is used in a claim, "the court must determine whether the patent provides some standard for measuring that degree." *Biosig Instruments, Inc. v. Nautilus, Inc.*, 783 F.3d 1374, 1378 (Fed. Cir. 2015) (quotation marks omitted). Likewise, when a subjective term is used in a claim, "the court must determine whether the patent's specification supplies some standard for measuring the scope of the [term]." *Datamize, LLC v. Plumtree Software, Inc.*, 417

F.3d 1342, 1351 (Fed. Cir. 2005). The standard "must provide objective boundaries for those of skill in the art." *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1371 (Fed. Cir. 2014).

In the context of a claim governed by 35 U.S.C. § 112, ¶ 6, the claim is invalid as indefinite if the claim fails to disclose adequate corresponding structure to perform the claimed function. *Williamson*, 792 F.3d at 1351–52. The disclosure is inadequate when one of ordinary skill in the art "would be unable to recognize the structure in the specification and associate it with the corresponding function in the claim." *Id*. at 1352.

III. CONSTRUCTION OF DISPUTED TERMS

A. "determining a delay … wherein said determination of said delay enables beamforming"

Disputed Term[4]	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"determining a delay between each of said sound sensors and an origin of said array of said sound sensors as a function of distance between each of said sound sensors and said origin, a predefined angle between each of said sound sensors and a reference axis, and an azimuth angle between said reference axis and said target sound signal, when said target sound source that emits said target sound signal is in a two dimensional plane, wherein said delay is represented in terms of number of samples, and wherein said determination of said delay enables beamforming" • Claim 1	plain and ordinary meaning	excludes identifying the direction exhibiting maximum energy among beams pointing in each of a prescribed number of directions

[4] For all term charts in this order, the claims in which the term is found are listed with the term but: (1) only the highest-level claim in each dependency chain is listed, and (2) only asserted claims identified in the parties' Joint Claim Construction Chart Pursuant to P.R. 4-5(d) (Dkt. No. 76) are listed.

Disputed Term[4]	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"determining a delay between each of said sound sensors and an origin of said array of said sound sensors as a function of distance between each of said sound sensors and said origin, a predefined angle between each of said sound sensors and a first reference axis, an elevation angle between a second reference axis and said target sound signal, and an azimuth angle between said first reference axis and said target sound signal, when said target sound source that emits said target sound signal is in a three dimensional plane, wherein said delay is represented in terms of number of samples, and wherein said determination of said delay enables beamforming" • Claim 20		

Because the parties' arguments and proposed constructions with respect to these terms are related, the Court addresses the terms together.

The Parties' Positions

Plaintiff submits: These terms do not need to be construed and there is nothing in the intrinsic record to justify Defendants' negative limitation. Rather than disclaiming the maximum-energy approach that Defendants seek to exclude from the scope of the claims, the patentee explained during prosecution of the '049 Patent that a prior-art reference ("*Tashev*") "did not teach any delay." Further, the '049 Patent includes embodiments that use power in calculations. Dkt. No. 68 at 7–9.

In addition to the claims themselves, Plaintiff cites the following **intrinsic evidence** to support its position: '049 Patent col.2 ll.30–33, col.6 ll.6–12, col.6 ll.54–59, col.11 l.25 – col.12 l.17; '049 Patent File Wrapper January 29, 2018 Response at 26 (Plaintiff's Ex. C, Dkt. No. 68-4 at 27).

Defendants respond: During prosecution of the '049 Patent, the patentee distinguished *Tashev* by characterizing the reference as teaching "identifying 'the direction exhibiting maximum energy' among beams pointing in 'each of a prescribed number of directions'" rather than teaching the determining limitation. Thus, the patentee disclaimed "identifying the direction exhibiting maximum energy among beams pointing in each of a prescribed number of directions" from the scope of the determining limitations, even if the claims otherwise allow for use of power. Dkt. No. 69 at 18–20.

In addition to the claims themselves, Defendants cite the following intrinsic and extrinsic evidence to support their position: **Intrinsic evidence**: '049 Patent January 29, 2018 Response at 24–25, 28 (Defendants' Ex. R, Dkt. No. 69-19 at 25–26, 29). **Extrinsic evidence**: Stern Decl.[5] ¶ 55 (Defendants' Ex. X, Dkt. No. 69-25).

Plaintiff replies: The patentee distinguished *Tashev* on the ground that *Tashev* did not teach using a delay rather than disclaiming "identifying the direction exhibiting maximum energy among beams pointing in each of a prescribed number of directions" from the scope of the claimed invention. Dkt. No. 75 at 5.

Plaintiff cites further **intrinsic evidence** to support its position: '049 Patent File Wrapper January 29, 2018 Response at 25–27 (Plaintiff's Ex. C, Dkt. No. 68-4 at 26–28).

Analysis

The issue in dispute is whether "identifying the direction exhibiting maximum energy among beams pointing in each of a prescribed number of directions" was disclaimed from the scope of

[5] Declaration of Richard M. Stern in Support of Defendants' Responsive Claim Construction Brief. Plaintiff submitted the unsworn version of Dr. Stern's report as its Exhibit D, Dkt. No. 68-5. The Court cites both the sworn declaration and the unsworn report, but does not perceive a substantial difference in the content of these two documents.

the "determining a delay … wherein said determination of said delay enables beamforming" limitations. While "identifying the direction exhibiting maximum energy among beams pointing in each of a prescribed number of directions" cannot alone satisfy the "determining a delay …" limitations, the patentee did not disclaim "identifying the direction exhibiting maximum energy among beams pointing in each of a prescribed number of directions" from playing any role in the "determining a delay …" limitations, or in the claimed invention.

During prosecution of the '049 Patent, the patentee noted the claim language at issue here, and stated as follows:

> In paragraph [0062] of applicant's original application, applicant teaches that the delay **(x)** between each of the sound sensors **301** and the origin of the microphone array **201** is determined as a function of distance (d) between each of the sound sensors **301** and the origin, a predefined angle **(<D)** between each of the sound sensors **301** and a reference axis (Y) as exemplarily illustrated in **FIG. 5,** and an azimuth angle (9) between the reference axis (Y) and the target sound signal. The distance between each of the sound sensors in the microphone array and the origin can he same (see FIGS. 16A, 16B and 18 B), or different (see FIGS. 19A and 19B). The claimed method is applicable for both cases. The determined delay (x) is represented in terms of number of samples; see paragraph [0063], which discloses: "*the delay **(T)** can be represented as the product of the sampling frequency (fs) and the time delay (t). That is, T=fs*t. Therefore, the distance between the sound sensors in the microphone array and the origin corresponds to the time used for the target sound signal to travel the distance and is measured by the number of samples within that time period*." Once the delay is determined, the microphone array can be aligned to enhance the target sound signal from a specific direction.
>
> In contrast, Tashev discloses, *inter alia*, a system and process for sound source localization, by calculating the energy of each frame set of the microphone signal in the sequence they were captured. This energy value is used for both noise floor tracking and frame classification. Thus, the frame set passing the minimum energy threshold test is subjected to the beamsteering procedure. This involves computing the full spectrum energy for each of a prescribed number of directions. After finding the energy as a function of the direction angle, the direction exhibiting the maximum energy and a prescribed number of its neighboring (i.e., adjacent) search directions are interpolated. The result of the interpolation process is then designated as the direction identifying the location of the sound source; see Tashev paragraphs [0072]-[0074].
>
> Tashev does not teach or suggest a method for determining the delay **(x)** as a function of distance (d) between each of the sound sensors **301** and the origin, a

> predefined angle (<P) between each of the sound sensors **301** and a reference axis (Y) as exemplarily illustrated in **FIG. 5,** and an azimuth angle (9) between the reference axis (Y) and the target sound signal. Furthermore, Tashev does not teach calculation of time delay as shown in **FIG. 5** and **Tables 6A, 6B and 7B** of applicant's original application. Furthermore, Tashev does not teach or suggest that the distance between each of the sound sensors in the microphone array and the origin corresponds to the time taken for the target sound signal to travel the distance between each of the sound sensors and the origin and is measured by the number of samples within that time period.

'049 Patent File Wrapper January 29, 2018 Response at 24–26 (emphasis in original), Dkt. No. 68-4 at 25–27.

This statement is not the disclaimer that Defendants seem to suggest. Rather, the patentee characterized *Tashev* and stated that *Tashev* did not teach anything that alone or in the aggregate satisfies the "determining a delay …" limitations. In other words, *Tashev's* teaching of "computing the full spectrum energy for each of a prescribed number of directions. After finding the energy as a function of the direction angle, the direction exhibiting the maximum energy and a prescribed number of its neighboring (i.e., adjacent) search directions are interpolated" does not alone satisfy the "determining a delay …" limitations. The Court understands Defendants' proposed construction to be more restrictive, and to necessarily exclude "identifying the direction exhibiting maximum energy among beams pointing in each of a prescribed number of directions" from having any role in any of the processes of the recited "determining a delay …" step. The prosecution-history statements do not meet the exacting standard for such a disclaimer.

Accordingly, the Court rejects Defendants' proposed construction and determines that these terms have their plain and ordinary meanings without the need for further construction.

B. "digital signal processor"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"digital signal processor" • Claims 1, 20	plain and ordinary meaning	a processor that is programmable using an instruction set that provides more powerful mathematical computational abilities for processing digital signals than standard microprocessors like ARM and Intel x86

The Parties' Positions

Plaintiff submits: The term "digital signal processor" (DSP) does not need to be construed; it has its plain and ordinary meaning: "a device that processes digital signals." There is nothing in the intrinsic record to justify Defendants' negative limitation excluding ARM and Intel x86 processors. Given that the meaning of this term is not ambiguous, resorting to extrinsic evidence to interpret it would be improper. Further, Defendants' proposed construction injects ambiguity by defining a DSP based on its power relative to standard microprocessors and by raising temporal issues related to whether ARM processors of 2010 do not qualify as DSPs but later ARM processors may qualify. Finally, Defendants' expert witness did not consider whether ARM processors include DSP instruction sets. Dkt. No. 68 at 9–12.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '049 Patent col.15 ll.25–27, col.16 ll.27–29. **Extrinsic evidence**: Stern Dep. at 29:10–18, 30:3–10, 35:15 – 36:1, 41:2–7, 41:13 – 42:3, 44:22 – 45:7, 46:8–11, 46:21 – 47:4, 52:7–15 (Plaintiff's Ex. E, Dkt. No. 68-6 at 30–31, 36–37, 42–43, 45–48, 53); Arm Limited, Cortex-A53 webpage[6] (Plaintiff's Ex. H, Dkt. No. 68-9); Arm Limited,

[6] https://developer.arm.com/ip-products/processors/cortex-a/cortex-a53; Ex. 2 to Stern Dep.

Cortex-A72 webpage[7] (Plaintiff's Ex. I, Dkt. No. 68-10); Arm Limited, Cortex-A7 webpage[8] (Plaintiff's Ex. J, Dkt. No. 68-11); Arm Limited, Cortex-A8 webpage[9] (Plaintiff's Ex. K, Dkt. No. 68-12).

Defendants respond: The term "digital signal processor" (DSP) should be construed to clarify how a DSP is distinct from other processors. First, as known in the art and as used in the '049 Patent, a DSP is programmable and is therefore distinct from hard-wired circuits that process digital signals. Second, as known in the art and as explained during prosecution of the '049 Patent, a DSP is distinct from a standard microprocessor. A primary distinction between a DSP and a standard microprocessor is that a DSP utilizes an instruction set that is specialized for mathematical operations, thereby providing more powerful mathematical computation abilities than a standard microprocessor. That an ARM processor, a standard microprocessor, may include DSP "extensions" to the instruction set indicates that an ARM processor is itself not a DSP. Dkt. No. 69 at 10–18.

In addition to the claims themselves, Defendants cite the following intrinsic and extrinsic evidence to support their position: **Intrinsic evidence**: '049 Patent col.15 ll.45–49, col.16 ll.29–38; U.S. Patent App. No. 61/403,952[10] at 11–12 (Defendants' Ex. V, Dkt. No. 69-23 at 20–21); '049 Patent File Wrapper October 15, 2017 Office Action at 7 (Defendants' Ex. Q, Dkt. No. 69-18 at 9), January 29, 2018 Response at 2, 7, 9, 27 (Defendants' Ex. R, Dkt. No. 69-19 at 3, 8, 10, 28); U.S. Patent App. Publ'n No. 2004/0252845 at ¶¶ 26–29 (Defendants' Ex. W, Dkt. No. 69-24). **Extrinsic evidence**: Stern Decl. ¶¶ 22, 41–52 (Defendants' Ex. X, Dkt. No. 69-25); Stern Dep. at

[7] https://developer.arm.com/ip-products/processors/cortex-a/cortex-a72; Ex. 3 to Stern Dep.
[8] https://developer.arm.com/ip-products/processors/cortex-a/cortex-a7; Ex. 4 to Stern Dep.
[9] https://developer.arm.com/ip-products/processors/cortex-a/cortex-a8; Ex. 5 to Stern Dep.
[10] The '049 states a priority claim to U.S. Patent App. No. 61/403,952.

28:8–21, 45:24 – 46:4, 46:8–20, 50:23 – 52:5 (Plaintiff's Ex. E, Dkt. No. 68-6 at 29, 46–47, 51–53); McAlexander Decl. ¶ 29 (Plaintiff's Ex. B, Dkt. No. 68-3); McAlexander Dep. at 137:3–6 (Plaintiff's Ex. G, Dkt. No. 68-8 at 138); Arm Limited, Cortex-A53 webpage (Plaintiff's Ex. H, Dkt. No. 68-9); Arm Limited, Cortex-A7 webpage (Plaintiff's Ex. J, Dkt. No. 68-11); Arm Limited, Cortex-A8 webpage (Plaintiff's Ex. I, Dkt. No. 68-12); Tom Thompson, *Digital Signal Processor*, Computerworld March 12, 2001, at 66 (Defendants' Ex. G, Dkt. No. 69-8 at 2); Harry Newton, *Newton's Telecom Dictionary* at 308 (24th ed. 2008) (Defendants' Ex. H, Dkt. No. 69-9 at 4); *Comprehensive Dictionary of Electrical Engineering* at 194 (2d ed. 2005) (Defendants' Ex. I, Dkt. No. 69-10 at 4); Steven W. Smith, *The Scientist and Engineer's Guide to Digital Signal Processing* at 503–06 (2d ed. 1999) (Defendants' Ex. J, Dkt. No. 69-11 at 6–9); Gene Frantz, *Digital Signal Processor Trends*, IEEE Micro (2000), at 52–53, 55 (Defendants' Ex. K, Dkt. No. 69-12 at 2–3, 5); William Stallings, *Computer Organization and Architecture Designing for Performance* at xiv (8th ed. 2010) (Defendants' Ex. L, Dkt. No. 69-13 at 5); Alan Freedman, *The Computer Glossary – The Complete Illustrated Dictionary* at 121 (9th ed. 2001) (Defendants' Ex. M, Dkt. No. 69-14 at 4); R.B. Fisher et al., *Dictionary of Computer Vision and Image Processing* at 75 (2005) (Defendants' Ex. N, Dkt. No. 69-15 at 4); Edmund Lai, *Practical Digital Signal Processing for Engineers and Technicians* at 204–05 (2003) (Defendants' Ex. O, Dkt. No. 69-16 at 4–5); Analog Devices, *Mixed-Signal and DSP Design Techniques* (2000) (Defendants' Ex. P, Dkt. No. 69-17).

Plaintiff replies: The intrinsic record does not establish construing "digital signal processor" by other than its plain and ordinary meaning. For instance, the patentee did not disclaim, or even mention, ARM or Intel x86 microprocessors in the '049 Patent or during prosecution. Rather, the

claims were distinguished over the prior art "based on the functionality performed by a DSP." Dkt. No. 75 at 5–7.

Plaintiff cites further **intrinsic evidence** to support its position: '049 Patent File Wrapper January 29, 2018 Response at 23 (Defendants' Ex. R, Dkt. No. 69-19 at 24).

Analysis

The issues in dispute appear to distill to whether a "digital signal processor" is just anything capable of processing digital signals. It is not. This is a term of art that refers to a microprocessor specialized for mathematical processing of digital signals.

To begin, the Court rejects Plaintiff's suggestion that it would be improper to consult extrinsic evidence to determine the meaning of "digital signal processor" "unless it is shown the claim term is ambiguous." Plaintiff misunderstands the law. A claim term is "generally given … the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). The person of ordinary skill in the art is "deemed to read the words used in the patent documents with an understanding of their meaning in the field, and to have knowledge of any special meaning and usage in the field." *Multiform Desiccants, Inc. v. Medzam Ltd.*, 133 F.3d 1473, 1477 (Fed. Cir. 1998). Thus, a term's "customary meaning" in the art is important to the claim-construction process. *Phillips*, 415 F.3d at 1312–13. Even if the term is a "commonly understood word[]" with a "widely accepted meaning," "general purpose dictionaries may be helpful." *Id*. at 1314. For terms of art,

> the court looks to those sources available to the public that show what a person of skill in the art would have understood disputed claim language to mean. …Those sources include the words of the claims themselves, the remainder of the specification, the prosecution history, and extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art.

Id. (citation and quotation marks omitted). The customary meaning of a term is a factual issue that is often in dispute, requiring the court "to look beyond the patent's intrinsic evidence and to consult extrinsic evidence in order to understand, for example, the background science or the meaning of a term in the relevant art during the relevant time period." *Teva Pharm. USA, Inc. v. Sandoz, Inc.*, 574 U.S. 318, 331–32 (2015); *see also*, *Phillips*, 415 F.3d at 1319 ("because extrinsic evidence can help educate the court regarding the field of the invention and can help the court determine what a person of ordinary skill in the art would understand claim terms to mean, it is permissible for the district court in its sound discretion to admit and use such evidence"); *Vitronics Corp. v. Conceptronic*, 90 F.3d 1576, 1584 n.6 (Fed. Cir. 1996) ("Judges are free to consult such resources at any time in order to better understand the underlying technology and may also rely on dictionary definitions when construing claim terms, so long as the dictionary definition does not contradict any definition found in or ascertained by a reading of the patent documents."). Ultimately, claim terms are construed in two cooperative contexts: (1) the context of the person of ordinary skill in the art, with his understanding of the art and the meanings of terms of art, and (2) the context of the intrinsic record, in which the inventor defines and claims her invention. The Court is free to consult any evidence of record to properly construe claims in these contexts. *See, e.g.*, *Phillips*, 415 F.3d at 1324.

The issue before the Court with respect to "digital signal processor" (DSP) is not whether the term is used in the '049 Patent in accord with its customary meaning. Rather, the dispute is squarely over the customary meaning of the term. The intrinsic record alone does not resolve this dispute. Notably, Plaintiff—in arguing that a DSP is simply "a device that processes digital signals"—appears to advocate a "plain and ordinary" meaning that is untethered both from the art and from the patent. In essence, Plaintiff is either advocating a construction that is a functional abstraction

of a term that has a well-established and structural customary meaning in the art or it is advocating a broad customary meaning for which it presents no evidence. In either case, the Court rejects Plaintiff's construction.

The term "digital signal processor" (DSP) is a term of art with an established meaning as a processor specialized for mathematical processing of digital signals, and it is used in the '049 Patent according to this meaning. The common element across the various explanations of "digital signal processor" and "DSP" in the extrinsic record of evidence is that a DSP is a processor specialized for mathematically processing digital signals. For example, one technical dictionary of record provides that "digital signal processor (DSP) [is a] microprocessor specifically designed for processing digital signals. DSPs are typically well suited to perform multiplications and additions in chain, even in floating point." *Comprehensive Dictionary of Electrical Engineering* at 194 (2d ed. 2005), Dkt. No. 69-10 at 4. Another dictionary provides that a "DSP (1) (Digital Signal Processor) [is a] special-purpose CPU used for digital signal processing …. It provides extra fast instruction sequences, such as shift and add and multiply and add, commonly used in math-intensive signal-processing applications." Alan Freedman, *The Computer Glossary – The Complete Illustrated Dictionary* at 121 (9th ed. 2001), Dkt. No. 69-14 at 4. Similarly, a treatise of record provides: "Digital Signal Processors are microprocessors specifically designed to handle Digital Signal Processing tasks" and explains "Digital Signal Processing is carried out by mathematical operations." Steven W. Smith, *The Scientist and Engineer's Guide to Digital Signal Processing* at 503 (2d ed. 1999), Dkt. No. 69-11 at 6.

The DSP of the '049 Patent is uniformly described as mathematically processing digital signals. For example, the DSP receives "digital sound signals" from the audio codec and "implements the sound source localization unit 202, the adaptive beamforming unit 203, and the

noise reduction unit 207." '049 Patent col.15 ll.18–38. Each of these units perform mathematical processing of the digital sound signals. *See, e.g.*, *id*. at col.6 ll.6–31, col.11 l.25 – col.12 l.6 (sound source localization), col.7 l.33 – col.11 l.24 (beamforming), col.14 ll.19–61 (noise reduction).

While it is clear that a "digital signal processor" is a specialized processor, it is not clear that all Intel x86 and ARM processors are necessarily not DSPs, as Defendants appear to advocate. For example, one technical dictionary provides: "[a] digital signal processor is a specialized semiconductor device or specialized core in a semiconductor device." Harry Newton, *Newton's Telecom Dictionary* at 308 (24th ed. 2008), Dkt. No. 69-9 at 4. This suggests that a DSP is not necessarily a distinct processor, but may be a component of another processor. Further, Defendants' proposed negative limitation raises issues related to the evolution of Intel and ARM processors: even if Intel x86 and ARM processors at the effective filing date are universally not DSPs (and the Court does not find this), that does not mean that later versions of these processors may not qualify. For instance, one author notes a convergence of DSPs and other processor types: "Increasingly, DSPs and other types of microprocessors have borrowed structures from each other, so that the line sometimes seems blurred where one type of processor leaves off and another begins." Gene Frantz, *Digital Signal Processor Trends*, IEEE Micro (2000), at 53, Dkt. No. 69-12 at 3. Ultimately, whether a particular prior-art or accused processor is a DSP is a factual issue of infringement or validity for the jury.

Finally, the Court declines to read in Defendants' "programmable" and "instruction set" limitations. It is not clear that these terms clarify the meaning of "digital signal processor" beyond the Court's construction set forth below. For instance, will the Court later be asked to construe "instruction set," which term does not appear in the claims or the patent?

Accordingly, the Court construes this term as follows:

- "digital signal processor" means "microprocessor that is specialized for mathematical processing of digital signals."

C. "for said array of sound sensors in a plurality of configurations"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"for said array of sound sensors in a plurality of configurations" • Claims 1, 20	plain and ordinary meaning	with the sound sensors positioned in multiple physical layouts

The Parties' Positions

Plaintiff submits: There is no support in the intrinsic record for limiting the "configurations" of the sound sensors to "physical layouts." Dkt. No. 68 at 12–13.

In addition to the claims themselves, Plaintiff cites the following **intrinsic evidence** to support its position: '049 Patent Col.16 ll.29–31.

Defendants respond: In the '049 Patent, the "configurations" of the sound sensors refer to the physical layouts of the sensors. For example, the claims recite "an array of sound sensors positioned in a linear, circular, or other configuration." Dkt. No. 69 at 20–21.

In addition to the claims themselves, Defendants cite the following intrinsic and extrinsic evidence to support their position: **Intrinsic evidence**: '049 Patent, at [57] Abstract, col.2 ll.11–14, col.2 ll.23–26, col.5 ll.61–64, col.8 ll.34–40, col.15 ll.5–8, col.16 ll.29–31, col.18 ll.44–47. **Extrinsic evidence**: Stern Decl. ¶¶ 57–60 (Defendants' Ex. X, Dkt. No. 69-25).

Plaintiff replies: The term "configuration" has a broad meaning and should not be limited to physical layouts. Further, Defendants' proposed construction "seems to require that the sound sensors are arranged in more than one manner within the same system." Dkt. No. 75 at 7–8.

Analysis

The issue in dispute is whether the "configurations" of the sound sensors in the array necessarily refers to the physical layout of the sound sensors. It does, in the sense that it refers to the geometric positioning of the sensors.

While "configuration" may be a broad term, when describing the "array of sound sensors" in the context of the surrounding claim language and in the context of the description of the invention, "configuration" refers to the geometric (spatial) positioning of the sensors. For example, Claim 1 recites "an array of sound sensors positioned in a linear, circular, or other configuration." '049 Patent col.21 ll.29–31. Under the doctrine of *ejusdem generis*, this suggests that the "configuration" of the array is of a kind with "linear" and "circular" configurations, which are plainly geometric. *See, e.g.*, *IBM v. Iancu*, 759 F. App'x 1002, 1007–08 (Fed. Cir. 2019) (interpreting "a federation is a set of distinct entities, such as enterprises, organizations, institutions, etc." to be limited to "enterprises" and the like and to not encompass just any "entity" such as piece of physical equipment) (citing *Archer Daniels Midland Co. v. United States*, 561 F.3d 1308, 1313 (Fed. Cir. 2009) and *United States v. Nichols Copper Co.*, 29 C.C.P.A. 186, 191 (1941)). The claim term at issue here is found later in Claim 1, in the context of the "determination of said delay [between each of said sound sensors and an origin] enables beamforming for said array of sound sensors in a plurality of configurations." '049 Patent col.21 ll.54–57. From this, the Court understand the "plurality of configurations" of the array for which the beamforming is enabled corresponds to the "linear, circular, or other configuration" of the array set forth earlier in Claim 1. Claim 20 provides a similar context. In other words, the claims clarify that enabling beamforming through determination of the delay is not limited to arrays of a particular geometric configuration (such as linear or circular), but rather encompasses a wide variety of geometric

configurations. This understanding that the "configuration" or the sound sensors refers to geometric positioning of the sensors is consistent with the description of the invention. For example, the patent provides: "The sound sensors are positioned in an arbitrary planar configuration herein referred to as a 'microphone array configuration', for example, a linear configuration, a circular configuration, any arbitrarily distributed coplanar array configuration, etc." *Id*. at col.5 ll.61–64.

The Court does not understand the claims to require arrays in more than one geometric layout or any particular process to configure the array of sensors. As explained above, the claims recite that the "determining a delay" step is suitable for enabling beamforming in a variety of array configurations. This an attribute of the "determining a delay" step and does not mean that the claims require a variety of array configurations. Further, the claims are silent as to how the configuration of sensors is actually formed. This allows that a variety of configurations may be formed by other than physically placing the sensors in different positions. For example, a common set of sensors may form different array configurations by selectively enabling or disabling sensors in the set.

Accordingly, the Court construes this term as follows:

- "for said array of sound sensors in a plurality of configurations" means "for said array of sound sensors in a plurality of geometric layouts of the sound sensors."

D. "origin of said array of said sound sensors"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"origin of said array of said sound sensors" • Claims 1, 20	plain and ordinary meaning	location within the array at which no sound sensor is located

The Parties' Positions

Plaintiff submits: There is nothing in the intrinsic record that justifies limiting the origin to a location at which there is no sound sensor. During prosecution of a related pending application, the applicant distinguished a prior-art reference that described a two-sensor system ("*Erten*") on the ground that *Erten* uses the distance between sensors rather than the distances of the sensors from an origin, which, in a two-sensor system "would be at a point between the two sensors." This does not disclaim sensor arrays that have a sensor at the origin. Further, a sensor may be at the origin and still have the "predefined angle" required by the claim; the angle could be zero. Finally, the '049 Patent allows for a "linear array" of sensors and in such an array "it may not be possible to pinpoint a location within the array at which no sound sensor is located" (quotation marks omitted). Dkt. No. 68 at 13–15.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '049 Patent figs.5–7C, col.2 ll.42–49, col.8 l.8 – col.11 l.22; U.S. Patent App. No. 16/052,623[11] File Wrapper June 17, 2019 Response at 16 (Plaintiff's Ex. L, Dkt. No. 68-14 at 17). **Extrinsic evidence**: Stern Report[12] ¶¶ 69, 71 (Plaintiff's

[11] U.S. Patent App. No. 16/052,623 is a continuation of the application that issued as the '049 Patent.

[12] Expert Report of Dr. Richard M. Stern on Claim Construction. This is substantially identical to the Stern Decl. submitted by Defendants as their Exhibit X, Dkt. No. 69-25. *See* note 5, above.

Ex. D, Dkt. No. 68-5); Stern Dep. 66:19–24 (Plaintiff's Ex. E, Dkt. No. 68-6 at 67); Amazon.com Inc., graphic from webpage[13] (Plaintiff's Ex. F, Dkt. No. 68-7).

Defendants respond: A sensor at an origin would not have a definite "predefined angle" as required by the claims; thus, the origin must be at a point where there is no sensor. Specifically, the sensor at the origin would have an undefined angle rather than the "zero" angle Plaintiff suggests. This understanding is supported by the related-application prosecution distinction of the two-sensor system of *Erten* on the ground that *Erten* discloses using distance between sensors rather than distances of the sensors from the origin, which is not a distinction if the origin may be at the location of the one of the sensors. Ultimately, since it is not possible to have an undefined "predefined angle," the claims make sense only if the origin is a point at which no sensor is located. Dkt. No. 69 at 21–24.

In addition to the claims themselves, Defendants cite the following intrinsic and extrinsic evidence to support their position: **Intrinsic evidence**: '049 Patent figs.3, 5, 7A, 7C, 16A, 16B, 17A, 18B, 19A–19F, col.8 ll.23–29, col.8 ll.53–55; U.S. Patent App. No. 16/052,623[14] File Wrapper June 17, 2019 Response at 13–19 (Defendants' Ex. T, Dkt. No. 69-21 at 14–20). **Extrinsic evidence**: Stern Decl. ¶¶ 62–66, 68–72 (Defendants' Ex. X, Dkt. No. 69-25); McAlexander Dep. at 26:5–10 (Plaintiff's Ex. G, Dkt. No. 68-8 at 27); New Oxford American Dictionary at 60 (3d ed. 2010) (Defendants' Ex. S, Dkt. No. 69-20 at 4).

Plaintiff replies: The "origin" is simply a "a point of reference utilized by the claimed methods to identify the direction from which the target sound is coming." This does not exclude an origin

[13] https://www.amazon.com/Amazon-Echo-Bluetooth-Speaker-with-WiFi-Alexa-White/dp/B01E6AO69U

[14] U.S. Patent App. No. 16/052,623 is a continuation of the application that issued as the '049 Patent.

at the location of a sensor. In fact, the patent describes an embodiment of such a system in that it describes that sensor positions are "arbitrary," which allows a sensor at the origin. Dkt. No. 75 at 8.

Plaintiff cites further **intrinsic evidence** to support its position: '049 Patent col.14 l.64 – col.15 l.1.

Analysis

The issue in dispute appears to distill to whether the claims exclude a system in which a sensor is located at the origin of the array. They do not.

The "origin" of the claims is simply a reference point used for processing. For example, the patent provides: "To define the value of τ_n, an origin or a reference point of the microphone array 201 is defined; and then the distance d_n between each sound sensor 301 and the origin is measured, and then the angle Φ_n of each sound sensor 301 biased from a vertical axis is measured." '049 Patent col.8 ll.17–22. This comports with the use of "origin" in the claims. For example, Claim 1 provides:

> determining a delay between each of said sound sensors and an origin of said array of said sound sensors as a function of distance between each of said sound sensors and said origin, a predefined angle between each of said sound sensors and a reference axis, and an azimuth angle between said reference axis and said target sound signal

'049 Patent col.21 ll.45–51. This suggests that the specific location of the origin is not significant, so long as it can be used to define the delays (τ_n). Further, the Court is not convinced that the "predefined angle" of the claims, a term not presented for construction, must be defined in the manner Defendants propose in defense of their negative limitation. The claims simply state that the angle must be "predefined" not how it must be "predefined." Thus, this does not necessarily

exclude predefining the angle of a sensor at the origin with any value, so long as the delays may be determined.

Claims 1 and 20 are also open-ended "comprising" claims and thus allow for unrecited elements without straying from the scope of the claims. Defendants' proposed construction would effectively close the claim with respect to sensors at the origin, even if those sensors are not part of the array for which delays are determined. Nothing in Defendants' argument or evidence justifies closing the open-ended claims in this fashion. Specifically, the Court is not convinced that the applicant's statement in the pending related application amounts to a disclaimer of a sensor at the origin.

Accordingly, the Court rejects Defendants' proposed construction and determines that this term has its plain and ordinary meaning without the need for further construction.

E. "steering a directivity pattern"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"steering a directivity pattern" • Claims 1, 20	plain and ordinary meaning	changing the direction of a directivity pattern to point toward a location of the target sound source

The Parties' Positions

Plaintiff submits: There is nothing in the intrinsic record that justifies rewriting "steering" as "changing." In fact, Defendants' expert witness acknowledged that "steering" includes maintaining direction (in the context of "steering a car"). Finally, rewriting "steering" as "changing" would improperly render recitations of "adaptive" in the claims superfluous. Dkt. No. 68 at 15–17.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '049 Patent col.2 l.65 – col.3 l.4, col.6 l.13–

17, col.6 ll.60–64, col.7 ll.44–50, col.12 ll.23–27, col.12 ll.42–47. **Extrinsic evidence**: Stern Report ¶ 83 (Plaintiff's Ex. D, Dkt. No. 68-5); Stern Dep. 67:20–24 (Plaintiff's Ex. E, Dkt. No. 68-6 at 68).

Defendants respond: The claims require "adaptive" steering of the directivity pattern and thus require changing the direction of the directivity pattern. Dkt. No. 69 at 28–29.

In addition to the claims themselves, Defendants cite the following **extrinsic evidence** to support their position: Stern Decl. ¶¶ 83–84 (Defendants' Ex. X, Dkt. No. 69-25); McAlexander Dep. at 33:9 – 34:5, 137:22 – 138:4 (Plaintiff's Ex. G, Dkt. No. 68-8 at 34–35, 138–39).

Plaintiff replies: "Steering" the directivity pattern does not necessarily require changing the direction of the pattern. Dkt. No. 75 at 8–9.

Analysis

The issue in dispute distills to whether "steering" a directivity pattern necessarily entails changing the direction of the pattern. While "steering" plainly suggests an ability to change direction, it does not mandate an actual change of direction.

The meaning of "steering a directivity pattern" is readily accessible given the context of the surrounding claim language. For instance, Claim 1 recites:

> performing adaptive beamforming for steering a directivity pattern of said array of said sound sensors in a direction of said spatial location of said target sound signal by said adaptive beamforming unit, wherein said adaptive beamforming unit enhances said target sound signal and partially suppresses said ambient noise signals.

'049 Patent col.21 ll.61–67. The "steering" language at issue here indicates that the directivity pattern is directed at the spatial location of the target sound signal by the adaptive beamforming. Assuming, without agreeing,[15] that other language in the claims requires the direction of the

[15] See the Court's discussion on "adaptive beamforming" in Section L below.

directivity pattern actually be changed during operation of the method, there is no reason to read that limitation into "steering" and "steering" alone does not suggest that it must necessarily change direction.

Accordingly, the Court rejects Defendants' proposed construction and determines that this term has its plain and ordinary meaning without the need for further construction.

F. "target sound signal"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"target sound signal" • Claims 1, 20	plain and ordinary meaning	sound signal from a desired or target sound source, for example, a person's speech that needs to be enhanced

The Parties' Positions

Plaintiff submits: The term "target sound signal" does not need construction in order to be understood. Further, it should not be narrowly limited to an exemplary embodiment, as Defendants propose. Dkt. No. 68 at 17–19.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '049 Patent col.2 ll.8–11. **Extrinsic evidence**: Stern Report ¶ 85 (Plaintiff's Ex. D, Dkt. No. 68-5).

Defendants respond: The '049 Patent expressly defines this term, providing: "As used herein, the term 'target sound signal' refers to a sound signal from a desired or target sound source, for example, a person's speech that needs to be enhanced" (quoting '049 Patent col.2 ll.8–11). Dkt. No. 69 at 29.

In addition to the claims themselves, Defendants cite the following **intrinsic evidence** to support their position: '049 Patent col.2 ll.8–11, col.5 ll.27–30.

Plaintiff replies: What Defendants cites as definitional is actually exemplary, and the term should not be limited to an exemplary embodiment. Dkt. No. 75 at 9.

Analysis

The issue in dispute is whether "target sound signal" is defined in the '049 Patent. It is.

The '049 Patent provides:

> The method and system disclosed herein addresses the above stated need for enhancing acoustics of a target sound signal received from a target sound source, while suppressing ambient noise signals. ***As used herein, the term "target sound signal" refers to a sound signal from a desired or target sound source***, for example, a person's speech that needs to be enhanced.

'049 Patent col.2 ll.5–11 (emphasis added). This is clearly definitional, other than the listed example of "a person's speech that needs to be enhanced." The Court declines to include this example in the construction of the term as potentially improperly limiting. For example, Claims 1 and 20 of the '049 Patent are directed to "enhancing a target sound signal" without reference to speech. Given that "speech" is explicitly exemplary in the description and is not mentioned in the claims, the claims are not limited to speech. Further, in the context of the claims and the description of the invention, the defining nature of the "target sound signal" is that it comes from a desired or target source and is the subject of the enhancement. Including the speech example poses some risk that the jury will improperly require some additional or other nature somehow related to speech and provides little if any additional clarity to the meaning of the term.

Accordingly, the Court construes this term as follows:

- "target sound signal" means "sound signal from a desired or target sound source."

G. "target sound source"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"target sound source" • Claims 1, 20	plain and ordinary meaning	a sound source that the system identifies as being desired

The Parties' Positions

Plaintiff submits: The meaning of this term is readily apparent when taken in the context of the claims. Defendants' proposal improperly limits the claim language by requiring the system identify the sound source as desired. Dkt. No. 68 at 19–20.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '049 Patent col.2 ll.8–10, col.5 ll.27–29. **Extrinsic evidence**: Stern Report ¶ 86 (Plaintiff's Ex. D, Dkt. No. 68-5).

Defendants respond: The '049 Patent describes the "target" source as a "desired" source and indicates that it is the system that determines whether a source is "desired." Plaintiffs' construction fails to clarify "who would make the determination" and thus leaves claim scope unclear. Dkt. No. 69 at 30.

In addition to the claims themselves, Defendants cite the following intrinsic and extrinsic evidence to support their position: **Intrinsic evidence**: '049 Patent col.2 ll.8–11, col.5 ll.27–30. **Extrinsic evidence**: Stern Decl. ¶ 86 (Defendants' Ex. X, Dkt. No. 69-25).

Plaintiff replies: The '049 Patent describes "a sound signal from a *desired* **or** *target sound source*," suggesting that a "target" source is not necessarily "desired" (Plaintiff's emphasis). Further, the claims do not require any "determination" of whether a source is desired or a target. Dkt. No. 75 at 9.

Analysis

The issue in dispute appears to be whether "target" necessarily means "that the system identifies as being desired." It does not.

The Court rejects Defendants' proposed construction. Rewriting "target" as "desired" does not clarify claim scope and potentially injects ambiguity regarding the subjective nature of desire. Perhaps more importantly, including the "system identifies" limitation clearly injects a limitation not expressed in the claims. Specifically, the claims are silent on how a particular sound source is determined to be the "target" source. Rather, the claims are directed to enhancing the signal from that source, regardless of how that source is determined to be the "target." Simply, the "target sound source" is the source of the sound signal that is enhanced by the claimed methods (the "target sound signal"). This is plain from the claims without construction.

Accordingly, the Court rejects Defendants' proposed construction and determines that this term has its plain and ordinary meaning without the need for further construction.

H. "when said target sound source that emits said target sound signal is in a two dimensional plane" and "when said target sound source that emits said target sound signal is in a three dimensional plane"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"when said target sound source that emits said target sound signal is in a two dimensional plane" • Claim 1	plain and ordinary meaning	assuming the sound source is in the same two-dimensional plane as the sound sensors
"when said target sound source that emits said target sound signal is in a three dimensional plane" • Claim 20	plain and ordinary meaning	not assuming the sound source is in the same two-dimensional plane as the sound sensors

Because the parties' arguments and proposed constructions with respect to these terms are related, the Court addresses the terms together.

The Parties' Positions

Plaintiff submits: There is nothing in the intrinsic record that justifies Defendants' proposed "assuming" limitations. Claim 20 includes an "elevation angle" limitation not present in Claim 1. Thus "it is clear … that the target sound source is not in the same two-dimensional plane as the sound sensors" in Claim 20 and "that the target sound source is in the same two-dimensional plane as the sound sensors" in Claim 1. Dkt. No. 68 at 20–23.

In addition to the claims themselves, Plaintiff cites the following **intrinsic evidence** to support its position: '049 Patent col.12 ll.29–34.

Defendants respond: The "determining a delay" for the sound source in a "three dimensional plane" of Claim 20 is based on one additional variable over the "determining a delay" for the sound source in a "two dimensional plane" of Claim 1; namely, the "elevation angle." The lack of an "elevation angle" in Claim 1 indicates that determining presupposes the sound source is in the same two-dimensional plane as the sensor array. The presence of the "elevation angle" in Claim 20 indicates that predetermining does not require this coplanarity. This is described in the '049 Patent with reference to Figure 5 (source is in the same 2D plane as the array) and Figure 7A (source is not in the same 2D plane as the array). Thus, the "when said …" limitations refer to assumptions the system makes for the "determining a delay" step. Dkt. No. 69 at 30–33.

In addition to the claims themselves, Defendants cite the following intrinsic and extrinsic evidence to support their position: **Intrinsic evidence**: '049 Patent figs.5, 7A, col.2 ll.42–58, col.8 ll.47–56. **Extrinsic evidence**: Stern Decl. ¶¶ 87–96 (Defendants' Ex. X, Dkt. No. 69-25).

Plaintiff replies: The claims are silent regarding how to determine "when" the target is in a two-dimensional plane or a three-dimensional plane and thus it would be improper to include Defendants' proposed "assuming" language. Dkt. No. 75 at 9–10.

Analysis

There appears to be two issues in dispute. First, whether these terms should be construed to clarify the meanings of "in a two dimensional plane" and "in a three dimensional plane." They should. Second, whether the system necessarily "assumes" which scenario to apply. It does not.

The claim language would benefit from a clarifying construction regarding what it means to be 'in a two dimensional plane" or "in a three dimensional plane." The parties basically agree that the language at issue distinguishes the delay-determination process to be applied to a target source that is in the same plane as the sensors of the array from the process to be applied to a target source that is not in the same plane. This is set forth in the Court's claim construction below.

The Court rejects Defendants' "assuming" limitations as they fail to clarify claim scope and instead threaten to inject ambiguity or improperly limit the claims. For example, the claims are silent on how to determine "when" the target source is in a two dimensional plane or a three dimensional plane. Defendants would inject the limitation that determining "when" requires "assuming" two dimensional or not. This threatens to exclude a situation in which the two-dimensional / three-dimensional location is input, or estimated, or otherwise determined. Simply, Defendants have not established that this extra limitation should be read into claims.

Accordingly, the Court construes these terms as follows:

- "when said target sound source that emits said target sound signal is in a two dimensional plane" means "when said target sound source that emits said target sound

signal is treated as if it is in the same two dimensional plane as the sound sensors"; and

- "when said target sound source that emits said target sound signal is in a three dimensional plane" means "when said target sound source that emits said target sound signal is not treated as if it is in the same two dimensional plane as the sound sensors."

I. Order of Steps – Claim 1 and 20

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
A method for enhancing a target sound signal from a plurality of sound signals, comprising: providing a microphone array system comprising an array of sound sensors …; receiving said sound signals …; determining a delay between each of said sound sensors and an origin of said array …; estimating a spatial location of said target sound signal …; performing adaptive beamforming for steering a directivity pattern …; and suppressing said ambient noise signals …. • Claims 1, 20	plain and ordinary meaning	The steps recited in each independent claim require an order. The "determining" and "estimating" steps must both follow the "receiving" step, but the "determining" may or may not precede the "estimating."

Because the parties' arguments and proposed constructions with respect to these issues are related, the Court addresses the terms together.

The Parties' Positions

Plaintiff submits: The claim language is clear that certain steps must take place before others, but otherwise allows that steps may be performed in any order or concurrently. Dkt. No. 68 at 23–25.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '049 Patent col.5 l.26 – col.6 l.23; '049 Patent File Wrapper January 29, 2018 Response[16] at 2 (Plaintiff's Ex. C, Dkt. No. 68-4 at 3). **Extrinsic evidence**: Stern Report ¶ 102 (Plaintiff's Ex. D, Dkt. No. 68-5).

Defendants respond: Logic dictates an ordering of steps of the claimed methods. For example, the step of "receiving" a target signal must occur before the steps of "determining a delay" based on the azimuth angle of that signal and "estimating" the spatial location of that signal. Similarly, the step of "determining a delay" expressly "enables" beamforming and therefore must occur before the step of "performing adaptive beamforming." Likewise, the step of "performing adaptive beamforming" expressly "enhances" the target sound signal and the step of "suppressing" ambient noise expressly is for "further enhancing" the signal; thus, the "performing" which enhances must occur before the "suppressing" for "further enhancing." Dkt. No. 69 at 33–34.

In addition to the claims themselves, Defendants cite the following **extrinsic evidence** to support their position: Stern Decl. ¶¶ 97–100, 102–04 (Defendants' Ex. X, Dkt. No. 69-25).

Plaintiff replies: Nothing in the logic of the claims dictates that the "determining a delay" step must be completed before initiating the step of "performing adaptive beamforming" so long as "the ultimate determination of the delay enables beamforming." Dkt. No. 75 at 10–11.

Analysis

The issue in dispute appears to be whether the Court should impose an ordering limitation on Claims 1 and 20. Based on the record, the Court declines to impose any order that is not expressed in the plain language of the claims.

[16] Plaintiff cites "May 9, 2014 Amendment" but refers to "Ex. C" which is the January 29, 2018 Response. The Court did not find a May 9, 2014 file-wrapper entry in any of the exhibits that Plaintiff submitted.

Defendants have not established that the steps of the claims must be performed in a particular order. Indeed, Defendants position on what particular order must be followed is somewhat indefinite. For example, Defendants originally maintained that "[t]he steps recited in each independent claim must be performed in the recited order." Exhibit B to the parties Joint P.R. 4-3 Claim Construction and Prehearing Statement at B-6, Dkt. No. 66-2 at 6. In their brief, Defendants argue "[t]he steps recited in each independent claim require an order," but allow that "the order of 'determining' and 'estimating' may be reversed." Dkt. No. 69 at 33–34. This appears internally inconsistent. For example, Defendants argue that a "target signal must be ***received*** before its azimuth angle is used to ***determine*** delay" and that the "location of the target sound signal must be ***estimated*** before ***performing*** adaptive beamforming towards 'a direction of said spatial location,'" but Defendants allow that "the order of 'determining' and 'estimating' may be reversed." *Id*. Defendants thus take the position that the azimuth angle of the target signal (and therefore its direction) may be known without first "estimating a spatial location of said target signal from said received sound signals" but that the "estimating" must also be performed before steering the directivity pattern to this direction. This seems logically inconsistent. Defendants have also not taken any position on whether and what steps can be performed concurrently in whole or in part. Given this context, it is unclear what adopting Defendants' proposed construction would actually mean. Ultimately, Defendants have not persuaded the Court that a construction imposing any particular order on performance of the steps of the claims would be helpful or proper.

Accordingly, the Court rejects Defendants' proposed construction and holds that there is no specific ordering limitation in either Claim 1 or 20 that must be satisfied apart from the limitations expressed in the claims.

J. "sound source localization unit"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"sound source localization unit" • Claims 1, 20	plain and ordinary meaning alternatively, if 35 U.S.C. § 112, ¶ 6 • **function**: estimating a spatial location of said target sound signal from said received sound signals • **structure**: processor executing any one of the algorithms described in the '049 Patent at 6:6-12, 6:54-59, 11:25-12:6, Figure 8, and equivalents thereof	35 U.S.C. § 112, ¶ 6 • **function**: estimating a spatial location of said target sound signal from said received sound signals • **structure**: digital signal processor executing the steered response power-phase transform algorithm described in the '049 patent at 11:55-12:6 in connection with Figure 8

The Parties' Positions

Plaintiff submits: The term "sound source localization unit" does not invoke 35 U.S.C. § 112, ¶ 6 because: (1) the term is found in a method step, (2) the term does not use the word "means," (3) the term is a name for structure, and (4) the '049 Patent explains how the "sound source localization unit" interacts with other structural components. Even if § 112, ¶ 6 governed this term, the patent discloses multiple algorithms, and not only the SRP-PHAT algorithm identified in Defendants' proposed construction. Dkt. No. 68 at 25–29.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '049 Patent figs.2, 8, col.2 ll.11–17, col.2 ll.30–33, col.4 ll.21–34, col.5 ll.30–37, col.6 ll.6–12, col.6 ll.32–59, col.11 l.25 – col.12 l.6, col.15

ll.27–29, col.17 ll.9–13, col.18 ll.62–67. **Extrinsic evidence**: McAlexander Decl.[17] ¶¶ 41–42, 44 (Plaintiff's Ex. B, Dkt. No. 68-3); McAlexander Dep.[18] at 56:12–19, 73:20 – 74:1 (Plaintiff's Ex. G, Dkt. No. 68-8 at 57, 74–75); Stern Report ¶¶ 45, 75–77 (Plaintiff's Ex. D, Dkt. No. 68-5); Stern Dep. at 24:19 – 25:16, 62:23 – 63:4 (Plaintiff's Ex. E, Dkt. No. 68-6 at 25–26, 63–64).

Defendants respond: This term is governed by § 112, ¶ 6 because: (1) it uses the nonce term "unit," (2) the "sound source localization" prefix is merely a description of the function performed by the unit, and (3) nothing in the claims, including the DSP, is sufficient to perform the recited function. In fact, the examiner recognized that § 112, ¶ 6 governs this term in the apparatus claims during prosecution of the '049 Patent. Given that the "sound source localization unit" is implemented in a DSP, which can perform multiple functions, the structure of the unit is the SRP-PHAT algorithm described in the patent. The other algorithms identified by Plaintiff (TDOA and SRP) are described in the patent as "not" the algorithm for the sound source localization unit. Dkt. No. 69 at 25–28.

In addition to the claims themselves, Defendants cite the following intrinsic and extrinsic evidence to support their position: **Intrinsic evidence**: '049 Patent col.11 l.25 – col.12 l.17, col.15 ll.27–29, col.15 ll.45–49; '049 Patent File Wrapper October 15, 2017 Office Action at 3–7 (Defendants' Ex. Q, Dkt. No. 69-18 at 5–9). **Extrinsic evidence**: Stern Decl. ¶¶ 74–76, 79–81 (Defendants' Ex. X, Dkt. No. 69-25); McAlexander Decl. ¶¶ 46–48 (Plaintiff's Ex. B, Dkt. No. 68-3); McAlexander Dep. at 72:12–15, 75:13 – 76:13, 98:7 – 99:3 (Plaintiff's Ex. G, Dkt. No. 68-8 at 73, 76–77, 99–100).

[17] Declaration of Joseph C. McAlexander III Regarding Proposed Constructions and Definiteness of The Asserted Claims of U.S. Patent No. RE47,049.
[18] Deposition of Joseph C. McAlexander, III (Jan. 27, 2020).

Plaintiff replies: The structural nature of the sound source localization unit is informed by the claim-recited interactions to other structural components; therefore § 112, ¶ 6 does not apply. If § 112, ¶ 6 did apply, it would be improper to limit the structure to the SRP-PHAT algorithm, as that is simply an exemplary embodiment and the patent thus allows use of the disclosed TDOA and SRP algorithms. Dkt. No. 75 at 11–12.

Analysis

There are two issues in dispute. First, whether "sound source localization unit" is governed by § 112, ¶ 6. Second, if § 112, ¶ 6 applies, whether the structure is limited to the SRP-PHAT algorithm. The Court determines that this term is not governed by § 112, ¶ 6 and therefore does not address the second issue.

"Sound source localization unit" is a structural term that is meaningful to the scope of the method claims and as such is subject to analysis under § 112, ¶ 6. Method claims may include structural limitations that require the steps of the method be performed in, by, or on a specific structure. *See, e.g., Microprocessor Enhancement Corp. v. Tex. Instruments, Inc.*, 520 F.3d 1367, 1374–75 (Fed. Cir. 2008) ("Direct infringement of claim 1 is clearly limited to practicing the claimed method in a pipelined processor possessing the requisite structure."). Method claims may also recite structure that does not meaningfully alter the scope of the claims. *See, e.g., Cox Commc'ns, Inc. v. Sprint Commc'n Co. LP*, 838 F.3d 1224, 1229–30 (Fed. Cir. 2016) ("'processing system,' plays no discernable role in defining the scope of the claims. … the point of novelty resides with the steps of the[] methods, not with the machine that performs them. 'Processing system' is merely the locus at which the steps are being performed."). Here, the sound source localization unit is more than "merely the locus at which the steps are being performed." For example, Claim 1 recites "sound source localization unit, an adaptive beamforming unit, and a

noise reduction unit" with each unit responsible for distinct steps in the method. The recitation of multiple units, each with a specified role, indicates that these terms play a meaningful role in defining claim scope. As such, "sound source localization unit" may invoke § 112, ¶ 6, even though it is recited in a method claim. *See On Demand Mach. Corp. v. Ingram Indus.*, 442 F.3d 1331, 1341 (Fed. Cir. 2006) ("providing means for a customer to visually review" recited in a method claim triggered § 112, ¶ 6 analysis for the "means for a customer to visually review"); *Media Rights Techs., Inc. v. Capital One Fin. Corp.*, 800 F.3d 1366, 1368–69 (Fed. Cir. 2015) ("activating a compliance mechanism" recited in a method claim triggered § 112, ¶ 6 analysis for the "compliance mechanism").

Defendants have not overcome the presumption against applying § 112, ¶ 6. The Court begins with the presumption that § 112, ¶ 6 does not apply because the term does not include the "means" language traditionally used to signal application of the statute. *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1347–49 & n.3 (Fed. Cir. 2015) (en banc in relevant portion). This "presumption can be overcome and § 112, para. 6 will apply if the challenger demonstrates that the claim term fails to recite sufficiently definite structure or else recites function without reciting sufficient structure for performing that function." *Id.* at 1349 (quotation marks omitted). "[T]he mere fact that the disputed limitations incorporate functional language does not automatically convert the words into means for performing such functions." *Zeroclick, LLC v. Apple Inc.*, 891 F.3d 1003, 1008 (Fed. Cir. 2018). "The question whether [a term] invokes section 112, paragraph 6, depends on whether persons skilled in the art would understand the claim language to refer to structure, assessed in light of the presumption that flows from the drafter's choice not to employ the word 'means.'" *Samsung Elecs. Am., Inc. v. Prisua Eng'g Corp.*, 948 F.3d 1342, 1354 (Fed. Cir. 2020). Here, Defendant has not overcome the presumption against § 112, ¶ 6.

"Sound source localization unit" connotes structure; namely, software/hardware in a DSP that includes functionality for locating a sound source. Claims 1 and 20 provide sufficient indications of the structural nature of the sound source localization unit by providing the objectives and operations of the sound source localization unit within the invention. For example, the claim recites that the sound source localization unit is "integrated in a digital signal processor" and is "in operative communication with said array of sensors" and further recites that its input is "said received sound signals" and its output is the "spatial location of said target sound signal." This suggests that § 112, ¶ 6 should not apply. *See, e.g., Linear Tech. Corp. v. Impala Linear Corp*., 379 F.3d 1311, 1319–21 (Fed. Cir. 2004) ("circuit [for performing a function]" found to be sufficiently definite structure because the claim recited the "objectives and operations" of the circuit); *Apple Inc. v. Motorola, Inc.*, 757 F.3d 1286, 1295, 1301 (Fed. Cir. 2014) ("heuristic [for performing a function]" found to be sufficiently definite structure in part because the claim described the operation and objectives of the heuristic); *Zeroclick, LLC v. Apple Inc.*, 891 F.3d 1003, 1008 (Fed. Cir. 2018) ("program that can [perform function]" found to be sufficiently definite structure in part because the claims provided operational context for the program); *Samsung Elecs. Am.*, 948 F.3d at 1347–48, 1353–54 ("digital processing unit … performing [functions]" found to be sufficiently definite structure in part because the claims provided operational context for the unit). Further, the patent describes the sound source localization unit as structural: it is a component of a DSP.[19] Finally, Plaintiffs' expert has opined that "sound source

[19] As Defendants note, during prosecution of the '049 Patent, the examiner at one point treated "sound source localization unit" in pending claims 9 and 21 as a means-plus-function limitation. The examiner then also treated "sound source localizer" in pending claims 26 and 31–35 as a means-plus-function limitation. '049 Patent File Wrapper October 5, 2017 Office Action at 3–7, Dkt. No. 69-18 at 5–9. The examiner at that point "consider[ed] the structure of the sound [source] localization unit or sound localizer to be a digital signal processor or equivalents thereof." *Id*. at 7, Dkt. No. 69-18 at 9. The patentee disagreed with the examiner that the terms are governed by

localization unit" is known in the art as structure. McAlexander Decl. ¶ 44, Dkt. No. 68-3 at 17–18. Given this context, Defendants have failed to overcome the presumption against application of § 112, ¶ 6.

Accordingly, Defendants have failed to establish that "sound source localization unit" should be governed by § 112, ¶ 6 and determines that this term has its plain and ordinary meaning without the need for further construction.

K. "an auditory transform based noise reduction algorithm"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"an auditory transform based noise reduction algorithm" • Claim 7	plain and ordinary meaning	indefinite

The Parties' Positions

Plaintiff submits: The term "auditory transform based noise reduction algorithm" is a term of art referring to a specific wavelet transform using "filters that emulate the cochlear filters present cochlea of the human ear." Dkt. No. 68 at 29–31.

In addition to the claims themselves, Plaintiff cites the following intrinsic and extrinsic evidence to support its position: **Intrinsic evidence**: '049 Patent col.14 ll.27–39. **Extrinsic evidence**: McAlexander Decl. ¶¶ 38, 40 (Plaintiff's Ex. B, Dkt. No. 68-3); McAlexander Dep. at 105:1–10, 108:10–22 (Plaintiff's Ex. G, Dkt. No. 68-8 at 106, 109); Stern Dep. at 70:15 – 71:4,

§ 112, ¶ 6. '049 Patent File Wrapper January 29, 2018 Response at 23–24, Dkt. No. 68-4 at 24–25. The patentee also modified all the pending independent claims to recite "digital signal processor." *Id*. at 3–20, Dkt. No. 68-4 at 6, 11–13, 17–20. The claims at issue here recite "digital signal processor," the very structure that the examiner identified as the structure of the "sound source localization unit."

77:16–20 (Plaintiff's Ex. E, Dkt. No. 68-6 at 71–72, 78); U.S. Patent No. 7,574,352 (in Plaintiff's Ex. B, Dkt. No. 68-3 at 66–91).

Defendants respond: The term "auditory transform based noise reduction algorithm" is not a term of art. The references relied upon by Plaintiff's expert do not use the term and distinguish auditory transforms from wavelet transforms rather than presenting them as a type of wavelet transform. Dkt. No. 69 at 9–10.

In addition to the claims themselves, Defendants cite the following **extrinsic evidence** to support their position: Stern Decl. ¶¶ 37–40 (Defendants' Ex. X, Dkt. No. 69-25); McAlexander Decl. ¶ 38 (Plaintiff's Ex. B, Dkt. No. 68-3); McAlexander Dep. at 124:5 – 125:2 (Plaintiff's Ex. G, Dkt. No. 68-8 at 125–26); Qi (Peter) Li, *An Auditory-Based Transform for Audio Signal Processing*, 2009 IEEE Workshop on Applications of Signal Processing to Audio and Acoustics (in Plaintiff's Ex. B, Dkt. No. 68-3 at 62–65); U.S. Patent No. 7,574,352 (in Plaintiff's Ex. B, Dkt. No. 68-3 at 66–91).

Plaintiff replies: The term is known in the art to refer to "a frequency-related representation of the sound signal over time which can be used to in processing to filter noise." Dkt. No. 75 at 12–13.

Analysis

The issue in dispute is whether the meaning of "auditory transform based noise reduction algorithm" is reasonably certain. It is.

Based on the record before the Court, the term "auditory transform" is a term of art, which provides sufficient guidance to make the scope of "an auditory transform based noise reduction algorithm" reasonably certain to one of ordinary skill in the art. The term "auditory transform based noise reduction algorithm" is plainly a noise reduction algorithm that is based on an

"auditory transform." The evidence of record indicates "auditory transform" is a term of art. For example, U.S. Patent No. 7,574,352 provides "[a] method of processing an acoustic signal is provided that prepares a frequency-related representation of the acoustic signal over time (e.g., spectrogram, wavelet transform or ***auditory transform***) and computes a two dimensional transform, such as a 2-D Fourier transform, of the frequency related representation to provide a compressed frequency related representation." U.S. Patent No. 7,574,352 col.1 ll.53–59, Dkt. No. 68-3 at 83. Thus, even if the entire phrase "auditory transform based noise reduction algorithm" is not a term of art, the constituent terms have customary meanings and are used in the phrase according to those meaning. As such, the meaning of the phrase "auditory transform based noise reduction algorithm" is reasonably certain based on the meanings of the constituent terms.

Accordingly, Defendants' have not proven any claim is indefinite for including "an auditory transform based noise reduction algorithm."

L. "adaptive beamforming"

Disputed Term	Plaintiff's Proposed Construction	Defendants' Proposed Construction
"adaptive beamforming" • Claim 1, 20	plain and ordinary meaning	a beamforming process in which the directivity pattern of the microphone array is adaptively steered in the direction of a target sound signal emitted by a target sound source in motion, and which includes adaptively performing beam steering and null steering

The Parties' Positions

Plaintiff submits: The term "adaptive beamforming" is not defined in the '049 Patent as Defendants suggest. For instance, Claim 3, which depends from Claim 1, separately recites "target sound source is in motion" suggesting that it would be improper to read that limitation into Claim

1. As described in the patent, "adaptive beamforming" is capable of working with a moving target, but does not require a moving target. Further, Claim 1 recites "performing adaptive beamforming for steering a directivity pattern of said array of said sound sensors in a direction of said spatial location of said target sound signal by said adaptive beamforming unit"; thus, the Defendants propose a construction that includes steering language that is substantially duplicative of the steering language expressed in the claims. Finally, the patent's description of "beam steering" and "null steering" is a description of the advantages of "adaptive beamforming" rather than a definition. Dkt. No. 68 at 31–35.

In addition to the claims themselves, Plaintiff cites the following **intrinsic evidence** to support its position: '049 Patent col.12 ll.23–38.

Defendants respond: The '049 Patent defines "adaptive beamforming," stating that the term "refers to" a specific process involving adaptive steering of the directivity pattern "in the direction of a target sound signal emitted by a target sound source in motion" and that it "adaptively performs beam steering and null steering" (quoting '049 Patent col.12 ll.23–42). As the patent states that the term "refers to" the specific process, it is stating a definition rather than just listing exemplary advantages. Dkt. No. 69 at 6–9.

In addition to the claims themselves, Defendants cite the following intrinsic and extrinsic evidence to support their position: **Intrinsic evidence**: '049 Patent col.12 ll.23–42. **Extrinsic evidence**: Stern Decl. ¶ 36 (Defendants' Ex. X, Dkt. No. 69-25); McAlexander Decl. ¶ 34 (Plaintiff's Ex. B, Dkt. No. 68-3); McAlexander Dep. at 49:3–13, 50:1–12 (Plaintiff's Ex. G, Dkt. No. 68-8 at 50–51).

Plaintiff replies: The language that Defendants rely upon is exemplary, not definitional. Notably, the patent's use of "refers to" instead of "is" or "means" suggests something other than a definition. Dkt. No. 75 at 13–14.

Analysis

The issue in dispute appears to distill to whether "adaptive beamforming" necessarily requires: (1) a target source in motion and (2) adaptively performing beam steering and null steering. It does not.

The '049 Patent sets forth a definition of "adaptive beamforming." Specifically, the patent provides:

> FIG. 10 exemplarily illustrates a system for performing adaptive beamforming by the adaptive beamforming unit 203. The algorithm for fixed beamforming is disclosed with reference to equations (3) through (8) in the detailed description of FIG. 4, FIGS. 6A-6B, and FIGS. 7A-7C, which is extended herein to adaptive beamforming. ***Adaptive beamforming refers to*** a beamforming process where the directivity pattern of the microphone array 201 is adaptively steered in the direction of a target sound signal emitted by a target sound source in motion. Adaptive beamforming achieves better ambient noise suppression than fixed beamforming. This is because the target direction of arrival, which is assumed to be stable in fixed beamforming, changes with the movement of the target sound source. Moreover, the gains of the sound sensors 301 which are assumed uniform in fixed beamforming, exhibit significant distribution. All these factors reduce speech quality. On the other hand, adaptive beamforming adaptively performs beam steering and null steering; therefore, the adaptive beamforming method is more robust against steering error caused by the array imperfection mentioned above.

'049 Patent col.12 ll.18–38 (emphasis added). While the statement "[a]daptive beamforming refers to a beamforming process where the directivity pattern of the microphone array … is adaptively steered in the direction of a target sound signal emitted by a target sound source in motion" is definitional, the definition needs to be understood in context. In this passage, "adaptive beamforming" is being defined in part relative to "fixed beamforming." Unlike fixed beamforming, in which the target is "assumed to be stable," active beamforming steers the directivity pattern to track a target in motion. This does not mean, as Defendants seem to suggest,

that adaptive beamforming requires the target to be in motion. Rather, it states a capability of adaptive beamforming that is not present in fixed beamforming. Denoting capability through use of active language, while perhaps unconventional, is acceptable in patent drafting. *See Mastermine Software, Inc. v. Microsoft Corp.*, 874 F.3d 1307, 1315–16 (Fed. Cir. 2017).

The Court declines to read in the "adaptively performing beam steering and null steering" limitations that Defendants' propose. The Court understands "adaptive beamforming adaptively performs beam steering and null steering" from the above-quoted passage to be a statement of the result of adaptively steering the directivity pattern to track a moving target. It is not an additional characteristic of "adaptive beamforming." Further, and as described above, it denotes a capability rather than a necessary action.

Accordingly, the Court construes "adaptive beamforming" as follows:

- "adaptive beamforming" means "a beamforming process where the directivity pattern of the microphone array is capable of being adaptively steered in the direction of a target sound signal emitted by a target sound source in motion."

IV. CONCLUSION

The Court adopts the constructions set forth above, as summarized in the following table. The parties are **ORDERED** that they may not refer, directly or indirectly, to each other's claim-construction positions in the presence of the jury. Likewise, the parties are **ORDERED** to refrain from mentioning any portion of this opinion, other than the actual definitions adopted by the Court, in the presence of the jury. Any reference to claim-construction proceedings is limited to informing the jury of the definitions adopted by the Court.

The parties are hereby **ORDERED** to file a Joint Notice within fourteen (14) days of the issuance of this Memorandum Opinion and Order indicating whether the case should be referred

for mediation. If the Parties disagree about whether mediation is appropriate, the Parties should set forth a brief statement of their competing positions in the Joint Notice.

Section	Term	Construction
	"determining a delay between each of said sound sensors and an origin of said array of said sound sensors as a function of distance between each of said sound sensors and said origin, a predefined angle between each of said sound sensors and a reference axis, and an azimuth angle between said reference axis and said target sound signal, when said target sound source that emits said target sound signal is in a two dimensional plane, wherein said delay is represented in terms of number of samples, and wherein said determination of said delay enables beamforming" • Claim 1	plain and ordinary meaning
A	"determining a delay between each of said sound sensors and an origin of said array of said sound sensors as a function of distance between each of said sound sensors and said origin, a predefined angle between each of said sound sensors and a first reference axis, an elevation angle between a second reference axis and said target sound signal, and an azimuth angle between said first reference axis and said target sound signal, when said target sound source that emits said target sound signal is in a three dimensional plane, wherein said delay is represented in terms of number of samples, and wherein said determination of said delay enables beamforming" • Claim 20	plain and ordinary meaning
B	"digital signal processor" • Claims 1, 20	microprocessor that is specialized for mathematical processing of digital signals

Section	Term	Construction
C	"for said array of sound sensors in a plurality of configurations" • Claims 1, 20	for said array of sound sensors in a plurality of geometric layouts of the sound sensors
D	"origin of said array of said sound sensors" • Claims 1, 20	plain and ordinary meaning
E	"steering a directivity pattern" • Claims 1, 20	plain and ordinary meaning
F	"target sound signal" • Claims 1, 20	sound signal from a desired or target sound source
G	"target sound source" • Claims 1, 20	plain and ordinary meaning
H	"when said target sound source that emits said target sound signal is in a two dimensional plane" • Claim 1	when said target sound source that emits said target sound signal is treated as if it is in the same two dimensional plane as the sound sensors
	"when said target sound source that emits said target sound signal is in a three dimensional plane" • Claim 20	when said target sound source that emits said target sound signal is not treated as if it is in the same two dimensional plane as the sound sensors
I	The order of steps of Claims 1 and 20	plain and ordinary meaning
J	"sound source localization unit" • Claims 1, 20	plain and ordinary meaning
K	"an auditory transform based noise reduction algorithm" • Claim 7	plain and ordinary meaning

Section	Term	Construction
L	"adaptive beamforming" • Claim 1, 20	a beamforming process where the directivity pattern of the microphone array is capable of being adaptively steered in the direction of a target sound signal emitted by a target sound source in motion

So ORDERED and SIGNED this 6th day of April, 2020.

RODNEY GILSTRAP
UNITED STATES DISTRICT JUDGE